A SHORT

ESSAY

WRITTEN FOR THE

SERVICE

OF THE

PROPRIETORS

OF

COTTON-MILLS,

AND THE

PERSONS EMPLOYED IN THEM.

By Mr John Bill, Surgeon

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A

SHORT ESSAY, &c.

THAT the ſuperiority of this county over many others, both with regard to riches and population, is in a great meaſure to be aſcribed to its Cotton Manufactory, is a truth which muſt be univerſally acknowledged. The advancement of this branch of commerce has therefore, for many years paſt, been ſought by every means which ingenuity could deviſe; and among the various inventions that have been made for this purpoſe, there are many which have ſeparately contributed very eſſentially to it. Of all theſe, none have been ſo ſucceſsful in anſwering the end propoſed, as the late diſcoveries in the art of Spinning and Carding, which are now united and perfected in the ſeveral cotton mills that have been erected, and which have proved ſo greatly advantageous, both to their proprietors and the county in general.

Though the Author of this little Eſſay profeſſes himſelf, generally ſpeaking, to be unacquainted with the nature of that art which is the ſource of ſo much affluence to this town and county, he heartily wiſhes ſucceſs and encreaſing improvement to every invention which can tend to its perfection, and would be happy to remove any objections to the cotton mills which may be ſuppoſed to ariſe from their pernicious influence on the health of the perſons employed in them.

That there has been a contagious diſorder in a cotton mill in the neighbourhood of Manchester, which has deſtroyed many perſons, and endangered the lives of more, is a well known fact. No apology therefore can be neceſſary for an attempt to inveſtigate the cauſe of it, as the pre-requiſite of its removal, and future prevention.

With reſpect to the nature of the diſeaſe, it can only be neceſſary to obſerve in a few words, that it was a malignant fever—that it generally ran through whole families, equally affecting people of all ages, but moſt fatal to the men—and that it was ſimilar to the fevers that frequently rage in jails, ſhips, and hoſpitals. From hence it is evident, that the cauſe of the former, muſt alſo reſemble that of the latter; and though it may not be eaſy, in any caſe, infallibly to demonſtrate, that any particular circumſtance was certainly, and ſingly, productive of any particular effect; (eſpecially where a

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ſimilar effect might poſſibly proceed from various ſources) it will be abundantly ſufficient to my preſent purpoſe, if I can point out a cauſe, which not only may, but which it is highly probable might, and which in its own nature, in a courſe of time, *muſt* produce it. To be rather more particular. It is impoſſible for any man to ſay, with reſpect to a contagious diſorder, whether in a mill or a jail, that it was not communicated by infection; but if he can prove, that it certainly might, and probably did ariſe, from any thing wrong in the conſtruction or management of either, or that it undoubtedly muſt do ſo in a courſe of time, he has certainly ſufficient reaſon to adopt this manner of accounting for it, and to juſtify any probable plan of redreſſing the inconvenience, which is founded upon the idea.

Now, nothing can be more certain, than that a fever of the kind we have been ſpeaking of, may, and in time *muſt* be produced from the effluvia which ariſe from a number even of healthy bodies, long confined in an unventilated place.

Many authentic facts may be adduced to prove the pernicious conſequences which ariſe from the ſtagnation of the air, in caſes where it may poſſibly be aggravated by uncleanneſs and diſeaſe: one or two of which it may not be improper to recite.

'At the fatal Aſſizes held at Oxford in the 'year 1577, there was arraigned and con-

'demned Rowland Jenkins, for a ſeditious 'tongue; at which time there aroſe ſuch a 'damp,' that is a noxious effluvia, 'amidſt the 'people, that almoſt all were ſmothered. Very 'few eſcaped that were not taken. There died 'in Oxon, three hundred perſons; and ſicken-'ed, but died in other places, two hundred 'and odd.'

'In the year 1750, on the 11th of May, the 'Seſſions began at the Old Bailey, and conti-'nued for ſome days; in which time a great 'number of criminals were tried, and there 'was preſent in the court a greater multitude 'than uſually attends. The hall in the Old 'Bailey is a room of no more than about 30 'feet ſquare. Now, whether the air was at 'firſt tainted from the bar, by ſome of the pri-'ſoners, then ill of the jail-diſtemper, or by 'the general uncleanneſs of ſuch perſons, is 'uncertain; ſince, from the latter cauſe it will 'be eaſy to account for its corruption; eſpeci-'ally as it was ſo much vitiated by the foul 'ſteams of the Bail-dock, and of the two 'rooms opening into the court, in which the 'priſoners were the whole day crowded toge-'ther, till they were brought out to be tried: 'and, it appeared afterwards, that theſe places 'had not been cleaned for ſome years. The 'poiſonous quality of the air was ſtill aggra-'vated by the heat and cloſeneſs of the court, 'and by the perſpirable matter of a great num-'ber of all ſorts of people, penned up for

moſt

moſt part of the day, without breathing the free air, or receiving any refreſhment. The bench conſiſted of ſix perſons, whereof four died, together with two or three of the counſel, one of the under ſheriffs, ſeveral of the Middleſex jury, and others preſent, to the amount of above forty in the whole; without making allowance for thoſe of a lower rank, whoſe death may not have been heard of, or including any that did not ſicken within a fortnight after the ſeſſions.' See Sir J. Pringle's Obſ. on the diſeaſes of the army.

Sir John Pringle has obſerved a malignant fever to have ariſen in foul and crowded barracks, and in tranſport ſhips when filled beyond a due number, and detained by long and contrary winds; or where the men were kept up at ſea, under cloſe hatches, during ſtormy weather.

The Guinea Merchants, it is well known, often experience great loſſes in their trade, from the number of ſlaves they loſe in their voyages, which muſt be attributed to the polluted air they are compelled to breathe. The Merchants, being aware of the cauſe of their deaths, have attempted to remove it; but ſo many negroes are ſtill crowded in the holds of the ſhips, that the meaſures they take to preſerve them, often prove ineffectual. They have been known to loſe all, except four, before they got to the place of deſtination.

Such are the conſequences of the want of a free

a free ventilation, when it may *poſſibly* be accompanied by other diſadvantageous circumſtances. But the propoſition I have laid down goes much farther, affirming (and the idea is founded upon experiment) that the niceſt cleanlineſs, and moſt perfect health, though they may poſtpone, cannot finally prevent, the bad effects of a ſtagnant air.

Many accurate experiments which have been made upon air reſpired from the lungs of healthy perſons, prove it to be a poiſon extremely deſtructive to the lives of animals. One man in health pollutes a gallon of air in a minute; and animals, even the moſt tenacious of life, ſooner expire in air thus made foul, than from the total want of it.

From theſe well-known facts, which are founded upon indiſputable evidence, it muſt appear very plain, that if air made foul by reſpiration in any given degree produces death, the various other degrees of it, muſt be productive of various, proportionably, pernicious conſequences; and amongſt others, as all thoſe acquainted with medical ſubjects will allow, of contagious fevers.

It might, indeed, as has been before intimated, be no eaſy matter to produce particular inſtances which will abſolutely prove, that ill effects have ariſen *ſolely* from the circumſtance of confining a number of healthy people in places not properly ventilated, becauſe in ſuch caſes it muſt always be impoſſible to ſay that

that no other cauſe co-operated with it: but the remarks which have been made are ſufficient to render the foregoing propoſition abſolutely certain—that if the effluvia ariſing from the bodies of men, even in health, be not diffuſed in the atmoſphere, they muſt at length occaſion a contagious fever: and further—that in all caſes where ſuch an effect is produced, and there is no more immediate cauſe of it apparent, it may reaſonably be attributed to this.

Now let us apply the general principle to the caſe immediately under conſideration.

The Cotton Mills are large buildings, but ſo conſtructed as to employ the greateſt poſſible number of perſons. That no room may be loſt, the ſeveral ſtories are built as low as poſſible. Moſt of the rooms are crowded with machines, about which it is neceſſary to employ a conſiderable quantity of oil, in order to facilitate their motion. From the nature of the manufacture, a great deal of cotton duſt is conſtantly flying about, which adhering to the oil, and heated by the friction, occaſions a ſtrong and diſagreeable ſmell. The number of people who work in the mill muſt certainly be proportioned to the ſize of it. In a large one I am informed there are ſeveral hundreds: from whence it is evident, a very conſiderable diviſion muſt be allotted to each apartment. The manufacturers, in many inſtances, conſtantly

ſtantly labour day and night.* Of courſe a great number of candles muſt be uſed, and ſcarce any opportunity for ventilation afforded. From hence it is evident that there is a conſiderable effluvia conſtantly ariſing from the bodies of a large number of perſons, (well, or in a degree indiſpoſed, juſt as it happens) from the oil and cotton duſt; and from the candles uſed in the night, without any conſiderable ſupply of freſh air. There are, indeed, trifling caſements, ſometimes opened, and ſometimes not; but totally inſufficient to ſubſerve any valuable purpoſe.

Now, if the mere confinement of a number of healthy bodies produce the effect above attributed to it, what conſequences muſt we expect from ſo many concomitant pernicious circumſtances?

What are the conſequences which have actually proceeded from them?——As we have already obſerved, it is well known, that there has been a contagious diſorder in a cotton mill in the neighbourhood of Mancheſter which has been fatal to many, and infected more: indeed, it ſpread itſelf throughout the village; and perhaps, for a ſimilar diſorder was prevalent, extended itſelf much further.

Moſt of the patients that were ill, having moſt

* It ſhould be obſerved, that the Proprietors of ſome Cotton Mills, alarmed by the conſequences of obliging their ſervants to work inceſſantly, have ſhut up their mills in the night.

been aſked where they caught the fever, either replied that they caught it themſelves at the cotton mill, or were infected by others that had. Several were aſked what kind of labour they followed, who were firſt ſeized with the diſorder. They all replied, they were the people that worked in the cotton mill; and if we admit the juſtice of the ſentiments already advanced, we ſhall find little difficulty in affording our aſſent to their idea of the ſource of the diſorder. Nothing leſs could be expected from ſuch cauſes, nor is there any other method of accounting for it, that is founded on the ſmalleſt degree of comparative probability.

If we attend to the natural effects of a merely ſtagnant air to thoſe who breathe it, and eſpecially if we reflect upon the conſequences that are ſure to reſult from it when rendered more pernicious by a noxious effluvia of any kind, we muſt acknowledge, as has been already ſhewn, that there is no affixing a limit to its dreadful influences.

But it may be aſked, why was not the fever produced ſooner, and why did any eſcape it? To the firſt of theſe enquiries we may reply, that the effect depends upon a variety of circumſtances. The mill might be kept cleaner at one time than another; and the number of perſons employed in it might be different; &c. &c. and after all, it muſt require ſome time to produce a degree of contamination, eſpecially in a new mill, which would be ſo extremely

prejudicial. To the ſecond of the above queries we may anſwer, that ſome people ſeem to be proof againſt the plague itſelf, and therefore their eſcape from it is far from being a ſufficient evidence that no danger exiſted.

The cauſe of the diſorder, which it is preſumed has been ſufficiently explained and eſtabliſhed, will ſuggeſt the method of its own removal and prevention. And as ſtagnant, contaminated air is the cauſe of the diſeaſe, the moſt obvious remedy is a free, conſtant, ventilation. It is not ſufficient to admit a ſcanty ſupply of air through a few ſmall windows, the building muſt be purified by a *full current*, which muſt be uniformly admitted at ſtated ſeaſons, and ſuffered to flow for a certain time, notwithſtanding any ſlight inconvenience to which it may expoſe the manufactory. This time ſhould not be leſs than ſix or eight hours in the four and twenty; and if the allowance could be encreaſed, ſo much the better. Various methods might be adopted for the ventilation of a mill, ſome of which it may not be improper to notice.

The firſt and beſt ſeems to be the following one; eſpecially as it is peculiarly adapted to the conſtruction of the cotton mills. In every window the ſaſhes ſhould be ſo formed, that the lower of them may be raiſed, and the upper let down. Upon this plan, a room will *comparatively* ſoon be purified from its tainted air. For as it is well known that noxious vapour aſcends,

aſcends, it will certainly eſcape through the higher aperture, while the freſh air ruſhes in through that beneath. If this mode of ventilation cannot be adopted ſo frequently, or for ſo long a time, as is neceſſary to produce the deſired effect, a conſiderable number of large ventilators, correſpondently ſituated, would prevent the injury the work might receive from an uninterrupted ſtream, and would, in ſome degree, ſupply its place; though they would by no means render it altogether unneceſſary.

Frequent fires in open grates may alſo be of great ſervice in ventilating the mills; though ſtoves cannot be equally beneficial, becauſe they do not produce an equal current of air. But this is a method, which if it can be employed at all, muſt rather be uſed in aid of another, than ſingly adopted, becauſe in any ſmall, and therefore ſafe degree, it would be inſufficient to the production of the deſired effect.

But though ventilation may be ſufficient to prevent the cauſe of diſeaſe in new mills, it will ſcarcely alone either remove it in them, or afford a good ſecurity againſt it, and ſtill leſs expel it, in old ones. It will be neceſſary therefore to have recourſe to ſome other methods of prevention and redreſs.

Wherever the contagious matter is thoroughly imbibed either in cotton wool or other porous ſubſtances, even in wood itſelf, other means muſt be made uſe of to eradicate it.

The ingenious Dr. Lind tells us that he 'ſeldom knew a proper application of fire and 'ſmoke to prove unſucceſsful in producing the 'happy conſequence of effectually purifying all 'tainted places, materials, and ſubſtances.'

'There are ſeveral methods commonly prac'tiſed for purifying ſhips, hoſpitals, or other 'places, after the company has been removed 'out of them.'

One of them is by the burning of tobacco—'A quantity of tobacco is ſpread on ſeveral 'fires made with ſuch old pieces of ropes, as 'are called junk. Theſe fires diſperſed into 'different places of the ſhip, their heat or ſmoke 'is afterwards cloſely confined below for a con'ſiderable time.'

Another method is, by burning wood and other vegetable productions that yield a ſubtil volatile acid, ſuch as pitch and tar, &c. in different parts of a building.

'The third method is, by charcoal fires, 'ſtrewed with brimſtone. The heat and ſteam 'of thoſe burning ſubſtances for this purpoſe 'muſt likewiſe be long and cloſe ſhut up. 'This fume properly applied hath been expe'rienced to purify effectually all tainted apart'ments, ſhips, cloaths, &c.'

'The fourth method of purification is per'formed by the burning of gunpowder. Of 'the many fumes recommended for the emen'dation of the air none are more effectual to 'eradicate an infection out of any place, than

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'the confined ſmoke of gunpowder.' The ventilators muſt be ſtopt, and as little air as poſſible admitted into the apartments, during the time ſmall quantities of gunpowder are fired off, in different parts of the building. 'A paſte may be made by thoroughly 'wetting the gunpowder with water. A ſmall 'quantity of this paſte, is to be thrown into the 'bottom of a broad and deep ladle, or an old ket-'tle or ſauce-pan, containing live coals, ſuffici-'ently ſecured by ſtanding in a deep bucket, 'or large tub of water. This precaution, with 'that of throwing only very ſmall quantities at 'a time of looſe powder on the wet paſte to 'promote its taking fire, will effectually ſecure 'againſt any danger. The operation is to be 'repeated, as long as the operator can ſtand 'the ſmoke (which by the bye is quite harm-'leſs to the lungs) and until the hold and all the 'parts between decks are ſufficiently replete 'with it. They ought to ſet fire to the laſt 'train juſt as they leave the gun-deck in aſcend-'ing the laſt ladder, when the hatchway, by 'which they came up, is without delay to be 'ſhut. The ſmoke muſt be confined for at leaſt 'two hours, until all the contents of the ſhips, '&c. are ſufficiently penetrated and purified with 'this vapour.'

The ventilators are afterwards to be played off, and all the windows and doors are to be ſet open, ſo that the apartments may receive a full ſtream of freſh and wholeſome air.

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'From the known and experienced efficacy 'of the proceſſes which have been deſcribed it 'appears that fire and ſmoke are the moſt pow-'erful agents for annihilating infection.'

Although the methods of purifying tainted places, which are above recited, may be adequate to the purpoſe, yet as the contagious matter is of ſo ſubtil a nature, it will be highly expedient to white-waſh the rooms three or four times every year; and one afternoon in the week ſhould be employed in ſcraping the floors and the frames of the machines, which ſhould afterwards be waſhed with *vinegar*, or ſome *vegetable* acid.

It is neceſſary alſo to be very careful that the oil which is uſed be perfectly ſweet; for if it be offenſive at firſt, it will become ſtill more ſo when heated by friction, and mingled with cotton duſt. We may add too, that it will be extremely proper frequently to cleanſe the ſpindles to which it is applied.

Air pipes are ſometimes uſed in large buildings pretty full of inhabitants, which, if they could be conveniently introduced, might probably be of conſiderable uſe in the mills.

It is further neceſſary to obſerve, that the Proprietors of Cotton Mills would do well to recommend it to their ſervants, to take great care, that the cloaths which have been expoſed to the matter of contagion, be thoroughly aired and cleanſed. For it is the opinion of

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ſeveral eminent phyſicians, that the effluvia ariſing from tainted cloaths, are much ſtronger than thoſe which proceed from the bodies, even of infected perſons.

We are aſſured on the beſt authority, that an infected belt was tranſported ſeveral thouſand miles, and communicated the diſeaſe to ſome Indians.

The beſt manner of purifying tainted cloaths is to put them in cold water or in cold ſoap lees for ſeveral hours, and then to fumigate them in the houſe where the infected perſon has lain, with charcoal fires and brimſtone, in the manner already directed for the purification of cotton mills. By theſe means both the houſe and the cloaths will be completely purified.

Theſe modes of purification are recommended by Dr. Lind.

From the foregoing obſervations it is very evident that it muſt be much for the intereſt of every gentleman, as well as the neighbourhood in which he lives, to attend to the health of all his ſervants: neither to admit any that are diſeaſed, nor to ſuffer others who are admitted to work in the manufactory, till they be perfectly cured.

It is true humanity will not permit them to ſuffer much from the want of employment in the interval of ſickneſs; but upon the ſlighteſt degree of reflexion it muſt appear, that they ought

ought on no account to be permitted to enter the mills.

The obſervations which have been already made, if they anſwer the purpoſe for which they were deſigned, will be fully ſufficient to remove, or in future to prevent the cauſe of that evil (the fever in the mills) which was the occaſion of them.

Were this trifle to be ſwelled to the ſize of a volume, it could with propriety contain but little more, than the different modes of ventilating this kind of buildings, and keeping them clean.

It may be uſeful however to remark the particular impropriety of expoſing children, to the pernicious conſequences of breathing a foul air, or of obliging them to work in the night.

Youth is the time in which, if ever, the foundation of health muſt be laid, and ſtrength of conſtitution acquired; and nothing can more powerfully tend to prevent either, than the want of pure air, and loſs of proper ſleep, at proper hours. With reſpect to the latter circumſtance, every one knows that ſleep in the day is not ſo refreſhing or ſtrengthening, as ſleep in the night: And it may alſo be added that their bodies being on this account rendered more weak and irritable, are probably more liable to receive the matter of contagion, if any exiſts. From hence it appears, that though children ſhould not imbibe a poiſon ſufficiently ſtrong to produce a fever,

ver, they will loſe the vigour of health, and become ſickly, feeble, comparatively unſerviceable, and perhaps deformed; for the tone of the ſyſtem being once deſtroyed, the bones may become ſoft and flexible and at length crooked.*

Cold bathing, provided other circumſtances do not forbid the uſe of it, would be extremely ſerviceable to children who have already ſuffered, or may be liable to ſuffer from any of the abovementioned cauſes; and perhaps it would be no leſs ſo to thoſe, who have yet received no injury in their health—Their parents ſhould alſo give them food before they ſend them to their work; by which means they will become much leſs likely to ſuffer from noxious effluvia or to be injured in other reſpects. Though this advice is peculiarly important to children; it by no means follows that it is of trifling conſequence to perſons of any age. In every caſe where health is poſſeſſed its obſervance will, generally ſpeaking, tend to its preſervation, and wherever it is injured or loſt, will have a proportionable tendency to the reſtoration of it.

* The Author of this Eſſay has been informed, that the children who work in the night, frequently ſleep in the ſame beds as thoſe who work in the day: if ſo, they alternately go out of a cloſe mill into a dirty bed, and into a room contaminated with noxious air. It can only be neceſſary to mention this circumſtance; the bad conſequences of it are ſufficiently obvious.

THE END.